Simpson®

INSTRUMENTS THAT STAY ACCURATE

OPERATOR'S MANUAL

SIMPSON 462 AUTORANGING DIGITAL MULTIMETER

WARNING

For safe usage, it is essential that the operator read this manual carefully before using the instrument for any measurements.

SIMPSON ELECTRIC COMPANY

853 Dundee Avenue, Elgin, Illinois 60120
(312) 697-2260 • Cable SIMELCO • Telex 72-2416
IN CANADA: Bach-Simpson, Ltd., London, Ontario
IN ENGLAND: Bach-Simpson (U.K.) Ltd., Wadebridge, Cornwall

DIGITAL INSTRUMENT Warranty

SIMPSON ELECTRIC COMPANY warrants each digital instrument manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory any digital instrument which shall within one (1) year after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service stations, with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sale of its products.

This warranty shall not apply to any digital instrument which shall have been repaired or altered outside the SIMPSON ELECTRIC COMPANY factory or authorized service stations, nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by the manufacturer.

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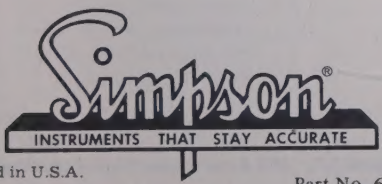

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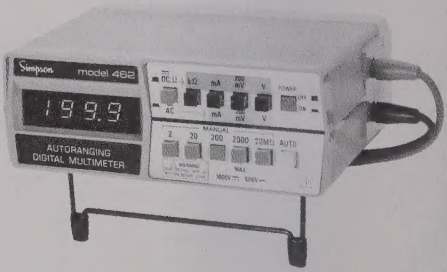


Figure 1-1. 462 Autoranging Digital Multimeter

TABLE OF CONTENTS

SECTION I
Introduction 1-1
1.1 General 1-1
1.2 Accessories and Supplies 1-2
1.3 Safety Considerations 1-2
1.4 Technical Data 1-2

SECTION II
Installation 2-1
2.1 General 2-1
2.2 Unpacking and Inspection 2-1
2.3 Warranty 2-1
2.4 Shipping 2-2
2.5 Power Source Requirements 2-2
2.6 Installation 2-2
2.7 Daily Care 2-3

SECTION III
Controls, Connectors, and Indicators 3-1
3.1 General 3-1
3.2 Front and Side Panel Description 3-1

SECTION IV
Operation 4-1
4.1 General 4-1
4.2 Safety Precautions 4-1
4.3 Preliminary Notes and Checks 4-3
4.4 General Functional Check 4-3
4.5 DC Voltage Measurement 4-4
4.6 AC Voltage Measurement 4-5
4.7 Resistance Measurements 4-6
4.8 DC Current Measurements 4-8
4.9 AC Current Measurements 4-9

SECTION V
Theory of Operation 5-1
5.1 Overall System 5-1
5.2 Input Circuits 5-3

Table of Contents

SECTION VI

Servicing Instructions 6-1

6.1 General 6-1
6.2 Cover Removal 6-1
6.3 Battery Installation 6-2
6.4 Battery Charging 6-3
6.5 Battery Care 6-3
6.6 Fuse Replacement 6-3
6.7 Troubleshooting 6-5
6.8 Replacement Parts and Schematic Diagram ... 6-9

LIST OF TABLES

1.1 Technical Data 1-2
1-2 Items and Accessories Furnished with this Instrument 1-8
3-1 Front and Side Panel Description 3-3
6-1 Troubleshooting Chart 6-6
6-2 Replacement Parts 6-9

LIST OF ILLUSTRATIONS

1-1 462 Digital Multimeter ii
3-1 Front Panel Description 3-1
3-2 Right Side Panel Description 3-2
3-3 Left Side Panel Description 3-2
5-1 Basic System Block Diagram 5-2
5-2 Basic Voltage Measurement Circuits 5-4
5-3 Basic DC Current and Resistance Measurement Circuits 5-7
6-1 462, Fuse Location 6-4
6-2 462, Schematic Diagram 6-13

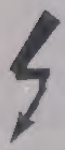
NOTE: This Operator's Manual contains information essential to the operation of this Instrument. Therefore, it should be kept in a convenient place and used for reference as required.

SYMBOL DEFINITIONS

A terminal to which or from which a direct voltage or current may be applied or supplied.

A terminal to which or from which an alternating (sinewave) voltage or current may be applied or supplied.

A terminal to which or from which an alternating or direct current or voltage may be applied or supplied (AC and/or DC).



HIGH VOLTAGE WARNING: An output terminal at which a voltage, with respect to another terminal or to earth ground, exists or may be adjusted to exceed 1000 volts AC or DC if a current exceeding 0.5 milliampere can be delivered into a 1500 ohm resistive load connected between the same points. The symbol is an additional warning that a very dangerous voltage may exist at the terminal, and the terminal and its connecting leads must not be handled while energized.

GROUNDED TERMINAL (PROTECTIVE): A terminal which must be connected to earth ground by the Operator or Installer prior to making any other connections to the equipment for personal protection from electric shock.

GROUNDED TERMINAL: A terminal which is connected to earth ground by means of an earth grounding system and which is intended to be connected to other circuits or equipment by the Operator or Installer for purposes other than protection from electric shock.

EXPLANATION: This marking adjacent to another marking or a terminal or operating device indicates that the Operator must refer to an explanation in the Operating Instructions to avoid damage to the equipment and/or to avoid personal injury.

WARNING

This Instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.

SHOCK HAZARD: As defined in American National Standard, C39.5, Safety Requirements for Electrical & Electronic Measuring & Controlling Instrumentation, a shock hazard shall be considered to exist at any part involving a potential in excess of 30 volts rms (sine wave) or 42.4 volts DC or peak and where a leakage current from that part to ground exceeds 0.5 milliamperes, when measured with an appropriate measuring instrument defined in Section 11.6.1 of ANSI C39.5.

NOTE: The proper measuring instrument for the measurement of leakage current consists essentially of a network of a 1500 ohm non-inductive resistor shunted by a 0.15 microfarad capacitor connected between the terminals of the measuring instrument. The leakage current is that portion of the current that flows through the resistor. The Simpson Model 229-Series 2 AC Leakage Current Tester meets the ANSI C39.5 requirements for the measurement of AC leakage current and can be used for this purpose. To measure DC Leakage current, connect a 1500 ohms non-inductive resistor in series with a Simpson 0-500 DC microammeter and use this as the measuring instrument.

SECTION I

INTRODUCTION

1.1 GENERAL

1.1.1 The 462 Autoranging Digital Multimeter (hereafter referred to as the 462, or the Instrument) is a compact, 3½ digit instrument suitable for use in general electronic maintenance, production, and laboratory. It features 0.25% DCV accuracy, integrated circuit electronics, solid-state LED display, and pushbutton switch selection, autoranging of voltage and ohm ranges are provided, as well as manual selection of any range. Additional features are automatic polarity, automatic zeroing, high input impedance for voltage measurements, and excellent temperature characteristics.

1.1.2 The 462 requires a line operated charger to charge its batteries and will operate for eight hours continuously on a full charge. Recharging is automatic when the Instrument is in the OFF position and with the charger connected to the powerline. (Refer to paragraph 6.3 for precaution and instructions.)

1.1.3 The 462 (Figure 1-1), measures DC and AC voltage, DC and AC current and resistance as specified in Table 1-1. The analog-to-digital (A/D) conversion circuitry is contained in one Large-Scale-Integration (LSI) module which provides high reliability and compact design.

1.1.4 The numerical display is a 7-segment light-emitting (LED) display for easy viewing and solid state reliability. The numbers are 0.3 inch high and in a single plane for distant and wide-angle viewing. Ambient lighting effects are minimized by a filter which reduces reflections and background illumination.

1.2 ACCESSORIES AND SUPPLIES

1.2.1 All supplies and accessories required for the operation of the 462 are furnished with each Instrument, and listed in the accompanying Table 1-2. Available replacement parts are listed in Table 7-1.

1.3 SAFETY CONSIDERATIONS

1.3.1 This Operator's Manual contains cautions and warnings alerting the user to hazardous operating and service conditions. This information is flagged by CAUTION or WARNING headings throughout this publication, where applicable, and is defined at the front of the manual under SAFETY SYMBOLS. To ensure the safety of operating and servicing personnel, and to retain the operating conditions of the Instrument, these instructions must be adhered to.

1.4 TECHNICAL DATA

1.4.1 Table 1-1 lists the technical data for the Simpson 462.

Table 1.1. Technical Data

1. DC VOLTAGE:

Range	Auto/ Manual	Maximum Indication	Overload Protected To Auto	Overload Protected To Manual
200mV	no/yes	±199.9mV	±1000V	±650V
2V	yes/yes	±1.999V	±1000V	±650V
20V	yes/yes	±19.99V	±1000V	±1000V

Table 1-1 (Con't)

200V	yes/yes	±199.9V	±1000V	±1000V
1000V	yes/yes	±1000V (Max. Input)	±1000V	±1000V

Input Resistance:	10MΩ
Accuracy: (23°C ±5°C)	±(0.25% of reading + 1 digit)
Sensitivity: Full Range	100μV on 200mV range
Step Response: (to rated accuracy)	3 seconds
Normal Mode Rejection:	40 dB minimum at 60Hz
Common Mode Rejection:	120 dB minimum at 60 Hz
Temperature Coefficient: (from 0°C to +55°C)	±(.025% of reading +.1 digit)/°C

2. AC VOLTAGE: (Average-Sensing, RMS Calibrated Sine Wave)

Range	Auto/ Manual	Maximum Indication	Overload Protected To Auto	Overload Protected To Manual
200mV	no/yes	199.9mV	600VRMS	240VRMS
2V	yes/yes	1.999V	600VRMS	240VRMS
20V	yes/yes	19.99V	600VRMS	600VRMS
200V	yes/yes	199.9V	600VRMS	600VRMS
600V*	yes/yes	600V (Max. Input)	600VRMS	600VRMS

*Frequency Range: 50 Hz to 400 Hz.

Input Impedance:	9MΩ and 100pF
Accuracy: (23°C ±5°C)	±(0.75% of reading + 2 digits[1]), 50 Hz to 1000 Hz ±(5.0% of reading + 2 digits[1]), 1000 Hz to 5kHz[2]

Table 1-1 (Con't)

Full Range Step Response: (to rated accuracy)	7 seconds
Temperature Coefficient: (from 0°C to +55°C)	±(0.05% of reading + 0.2 digit)/°C

3. RESISTANCE: (Auto or Manual)

Range	Maximum Indication	Test Current	Overload Protected To
2kΩ	1.999kΩ	1mA	250VRMS[3]
20kΩ	19.99kΩ	100μA	250VRMS[3]
200kΩ	199.9kΩ	10μA	250VRMS
2000kΩ	1999kΩ	1μA	250VRMS
20MΩ[4]	19.99MΩ	100nA	250VRMS

Accuracy: (23°C ± 5°C)	±(0.5% of reading + 1 digit) except on the 20 MΩ range, which is ±(1.0% of reading + 1 digit)
Sensitivity:	1.0Ω on 2kΩ range
Full Range Step Response: (to rated accuracy)	7 seconds
Full Scale Voltage:	2 Volts
Temperature Coefficent: (from 0°C to +55°C	±(0.05% of reading +.1 digit)/°C

4. DC CURRENT:(manual only):

Range	Maximum Indication	Full Range Voltage Drop	Overload Protected To
2mA	±1.999mA	200mV	±2.0A*
20mA	±19.99mA	200mV	±2.0A*
200mA	±199.9mA	200mV	±2.0A*
2000mA	±1999 mA	200mV	±2.0A*

*Fuse Protected

Table 1-1 (Con't)

Accuracy:	±(1.0% of reading + 1 digit), except on 2000mA which is ±(1.5% of reading + 1 digit)
Sensitivity:	1μA on 2 mA range
Full Range Step Response: (to rated accuracy)	1 second
Temperature Coefficient: (from 0° to +55°C)	±(0.05% of reading + 0.1 digit)/°C

5. AC CURRENT:(50 Hz to 1kHz) (manual only)

Range	Maximum Indication	Full Range Voltage Drop	Overload Protected To
2mA	1.999mA	200mV	2.0A*
20mA	19.99mA	200mV	2.0A*
200mA	199.9mA	200mV	2.0A*
2000mA	1999 mA	200mV	2.0A*

*Fuse Protected

Accuracy:	±(1.5% of reading + 5 digits), except on 2000 mA which is ±(2.0% of reading + 5 digits)
Full Range Step Response: (to rated accuracy)	5 seconds
Temperature Coefficient: (from 0°C to +55°C)	±(0.1% of reading + 0.2 digit)/°C

6. RATED CIRCUIT-TO-GROUND VOLTAGE:[5] ⚠

(Maximum Common Mode Voltage)	300 volts (DC plus peak AC) maximum from "—" or common terminal to powerline (earth) ground.

7. RESOLUTION: 1 part in 2000

Table 1-1 (Con't)

8. DISPLAY:

Numerical Display:	3½ digit, 7-segment light-emitting-diode (LED) type; display blanks, except for the most significant "1" digit at 2000 counts and above. (A LED will light in the 20MΩ range.)
Conversion Rate:	3 readings per second, nominal
DC Polarity Selection:	Automatic, "—" sign displayed; "+" sign implied
Ranging	
Auto:	Automatically upranges for readings 2000 and above: down ranges for readings below 180 counts.
Manual:	Switch selection of ranges.

9. POWER REQUIREMENT:

Battery Charging: (AC operating)	120 VAC ±10%, 50-400 Hz, 3VA nominal
Battery Operation:	Four nickel-cadmium "AF" size rechargeable cells, are included. (See Paragraph 6.3.1 for use with "AA" size rechargeable nickel-cadmium cells.)
Battery Operation Time: (continuous with fully charged battery)	8 hours, nominal
Battery Recharge Time:	12 hours, nominal

10. TEMPERATURE RANGE:

Operating:	0°C to +55°C
Storage:	−40°C to +60°C

Table 1-1 (Con't)

11. RELATIVE HUMIDITY:

Operating:	0 to 90% (non-condensing)

12. REFERENCE CONDITIONS:

Temperature:	+23°C ±1°C
Relative Humidity:	30 to 60%
Atmospheric Pressure:	575 to 800 mmHg to alt. of 2286m (7,500 ft.)

13. DIMENSIONS:

Height:	2 in. (50.8 mm)
Width:	5.63 in. (143 mm)
Depth:	4.6 in. (116.8 mm)

---

[1]+5 digits on 200 mV range

[2]Except 600 V range

[3]250 V for 5 seconds or less; 135 V Continuous

[4]MΩ Indicator will light

[5]Per ANSI C 39.5 April 1974—"the specified voltage with respect to ground which may be safely and continuously applied to the circuits of an instrument."

Table 1-2. Items and Accessories Furnished With This Instrument

Quantity	Description	Part No.
1	Operator's Manual	6-111465
2	Battery, AF size, 1.25V, 0.8 AMP-HRS Nickel-Cadmium	6-111333
1	Test Lead Set: One black and one red insulated lead having probe tips with provisions for screw-on alligator clips (one red and one black supplied).	10-830676
1	Battery Charger, 120 VAC	00745
1	Battery Charger, 120 VAC (UL listed)	00743

SECTION II

INSTALLATION

2.1 GENERAL

2.1.1 This section contains information and instructions for the installation and shipping of the 462. Included are unpacking and inspection procedures, warranty, shipping, power source requirements, installation, and daily care.

2.2 UNPACKING AND INSPECTION

2.2.1 Examine the shipping carton for signs of damage prior to unpacking. If there are none then unpack and inspect the Instrument for possible damage in shipment. Check the electrical performance as soon as possible. If damage is noted, notify the carrier and supplier before using the Instrument. Also, check that all furnished items and accessories are included (Table 1-2).

2.2.2 Save the shipping carton and packing materials for future storing or shipping of the Instrument.

2.3 WARRANTY

2.3.1 The Simpson Electric Company warranty policy is printed on the inside front cover of this manual. Read it carefully prior to requesting a warranty repair.

NOTE: For assistance of any kind, including help with the Instrument under warranty, contact the nearest Authorized Service Center for instructions (listed on the last pages of this manual). If you wish to contact the factory directly, give full details of the difficulty and include the Instrument model number, serial number (at the back of the Instrument) and date of purchase. Service data or shipping instructions will be sent to you promptly. If an estimate of charges for non-warranty or other service

work is required, a maximum charge estimate will be quoted. This charge will not be exceeded without prior approval.

2.4 SHIPPING

2.4.1 Pack the Instrument carefully and ship it prepaid to the proper destination. Insure the shipment.

2.5 POWER SOURCE REQUIREMENTS

2.5.1 The 462 is a battery operated instrument. **The batteries are factory installed in the instrument and should be charged overnight before operating.** Connect the charger (supplied) to the appropriate external power source. (Refer to the markings on the charger for power source requirements.)

WARNING

The 462 is designed specifically to be used with the Simpson 120 VAC Charger, Cat. No. 00745 or 00743, which is adequately insulated to permit use of the 462 while being charged.

CAUTION

Do not operate the Instrument unless the batteries are properly installed. See paragraph 6.3.

2.6 INSTALLATION

2.6.1 The Instrument may be set horizontally on its rubber feet or vertically on its back and operated in either position. The Instrument can also be set at an inclined angle by positioning the stand under the unit.

2.7 DAILY CARE

WARNING

Do not attempt to clean this Instrument with the test leads connected to a power source or when it is connected to the charger.

a. Immediately clean all spilled materials from the Instrument and wipe dry. If necessary, moisten a cloth with soap and water to clean plastic surfaces.

b. Do not allow the battery to fully discharge. A completely discharged battery may be forced into reverse polarity which will shorten battery life.

c. Whenever possible, avoid exposure or usage in areas which are subject to temperature and humidity extremes, vibration or mechanical shock, dust or corrosive fumes, or strong electrical or electromagnetic interference.

2.7.1 MONTHLY CARE: Verify Instrument calibration by performing operational checks using known value sources. If need for calibration is indicated, contact the nearest Authorized Service Center.

2.7.2 ANNUAL CARE: It is recommended that the Instrument be returned annually to an Authorized Service Center or the factory for a complete overall check and/or calibration.

2.7.3 STORAGE: When the Instrument is not in use, store it in a location free from temperature extremes, dust and corrosive fumes, and mechanical vibration or shock.

SECTION III

CONTROLS, CONNECTORS AND INDICATORS

3.1 GENERAL

3.1.1 All operating controls, connectors, and indicators are described in Table 3-1. Become familiar with each item prior to operating the Instrument for the first time.

3.2 FRONT AND SIDE PANEL DESCRIPTION

3.2.1 Table 3-1 lists all front and side panel controls, connectors, and indicators (Figures 3-1, 3-2, and 3-3 for identification).

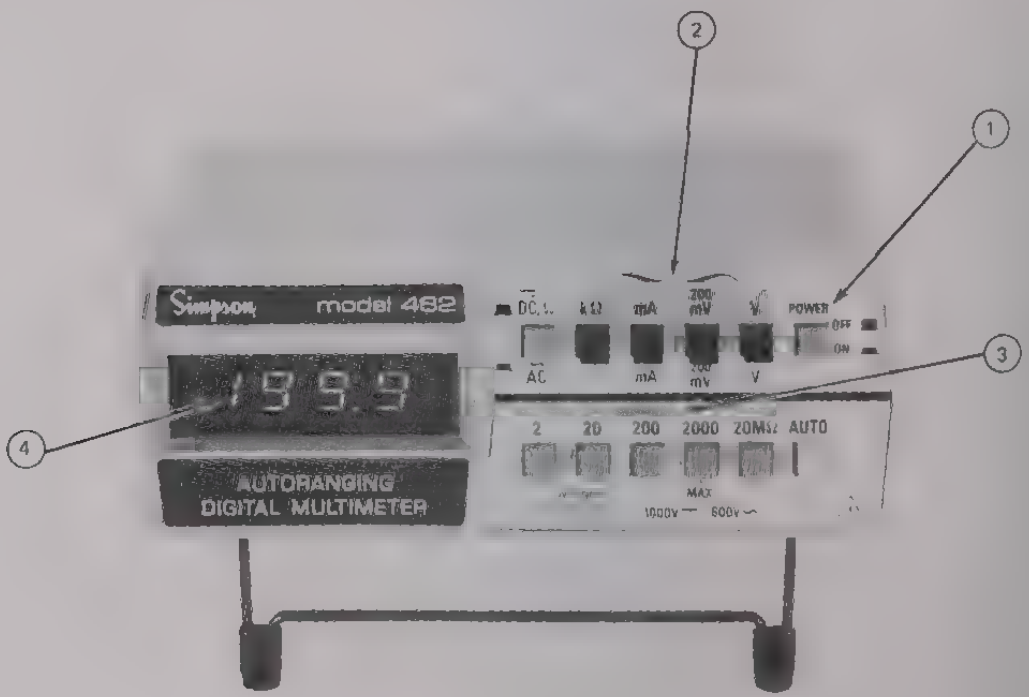


Figure 3-1. Front Panel Description

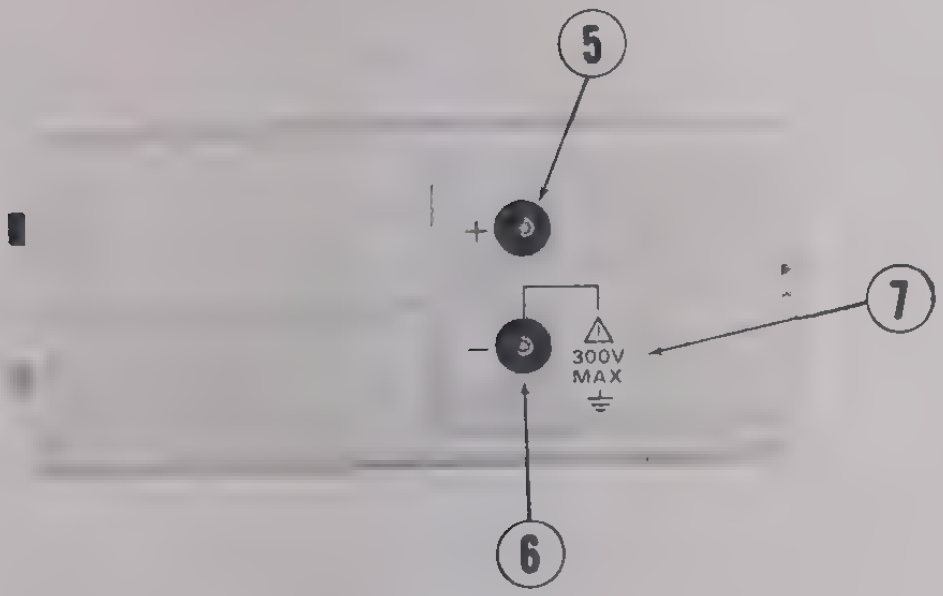


Figure 3-2. Right Side Panel Description

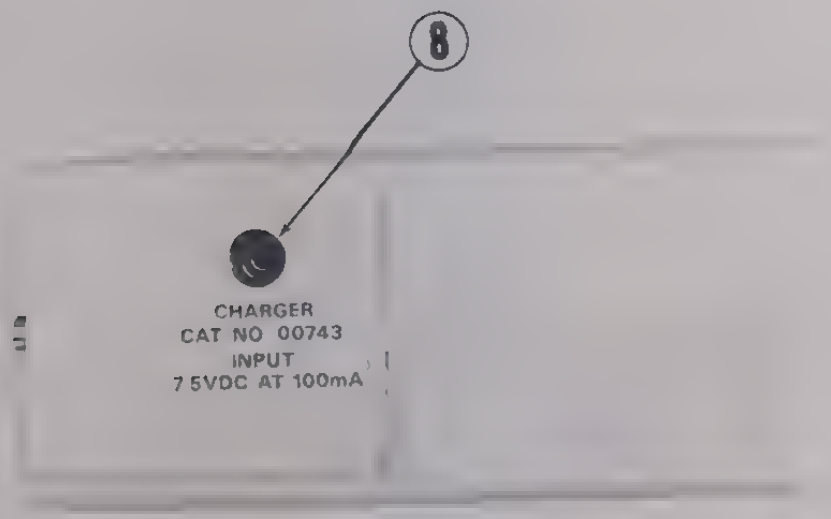


Figure 3-3. Left Side Panel Description

Table 3-1. Front and Side Panel Description

1. POWER Switch:

ON ▬ OFF ▮	Pushbutton switch used to apply or turn off power to the Instrument. (This switch does not control the battery charger voltage.)

2. FUNCTION Switches: (DC, Ω/AC)

OUT ▮ $\overline{\text{DC}}$, Ω	Selects the DC Voltage, DC current or resistance, measuring circuits, depending on the function switch position setting.
IN ▬ $\widetilde{\text{AC}}$	Selects the AC Voltage or AC current measuring circuits, depending on the function switch position. (The Instrument will not measure resistance in this position.)
KΩ mA 200mV V	Selects one of four functions to be measured, depending on position of $\overline{\text{DC}}$, Ω/$\widetilde{\text{AC}}$ switch.

3. RANGE SWITCHES:	Select autoranging (AUTO) or fixed range (MANUAL).
AUTO	Permits the Instrument to operate in the automatic range mode.

Table 3-1 (Con't)

MANUAL	Selects the appropriate circuits required to obtain full range measurements. This overrides the autoranging feature and allows the selection of any range.
4. NUMERICAL DISPLAY:	The digital display uses LED's and includes a polarity sign, ("—" displayed, "+" implied) a "1" digit, three 7-segment type 0 to 9 digits, a decimal point to indicate the polarity and the value of the signal being measured. The decimal point is properly positioned by the selection of the range switch or automatically selected in the autoranging mode. Over-range (or out-of-range) condition is indicated by a blank display, except for the most significant "1." Additionally a MΩ indicator illuminates whenever the 20MΩ range is selected.
5. "+" JACK:	This jack is used to connect, via the red test lead, the "high" or "+" side of the circuit being measured to all voltage and resistance and current measuring circuits through the range and function switches.
6. "—" JACK:	This jack is used to connect, via the black test lead, the "low" or "—" side of the circuit measured to the internal circuit COMMON and is isolated from the AC

Table 3-1 (Con't)

		powerline ground. Do not float this terminal more than 300 (DC plus AC peak) volts away from earth ground.
7.		Refer to Table 1-1, item 6.
8.	CHARGER INPUT:	This receptacle accepts the DC power from the charger.

SECTION IV

OPERATION

4.1 GENERAL

WARNING

Before proceeding with the operation of the 462 review the SHOCK HAZARD definition on page vi of this manual.

4.1.1 This section of the manual contains information required to use and operate the 462 in a safe and proper manner.

4.2 SAFETY PRECAUTIONS

4.2.1 The 462 is designed to be used only by personnel qualified to recognize shock hazards and trained in safety precautions required to avoid possible injury.

4.2.2 Do not work alone when making measurements where a shock hazard can exist. Notify another nearby person that you are .or intend to make such measurements.

CAUTION

Voltages might appear unexpectedly in defective equipment. An open bleeder resistor can result in a capacitor's retaining a dangerous charge. Remove all power and discharge all capacitors in the circuit being measured before making connections to or disconnections from it. The above precautions are wise even in the laboratory, and especially in field usage of the Instrument where many strange or unknown safety hazards might prevail.

4.2.3 Locate all voltage sources and accessible paths prior to making any measurements or connections.

4.2.4 Before each use, inspect the test leads (prods, wire and connectors), the power cord and plug (if any) and the instrument itself for any defects in their insulation or protection afforded. If any cracks, breaks, or crazes appear in insulation or if protective covers (meter glass or compartment covers or boots) are missing or damaged, repair or replace the defective items before using the instrument.

4.2.5 Do not make measurements in a circuit where corona is present. Corona can be identified by a pale-blue color emanating from sharp metal points in the circuit or a buzzing sound, or the odor of ozone. In rare instances, such as around germicidal lamps, ozone might be generated as a normal function. Ordinarily, the presence of ozone indicates presence of high voltage, and probably a malfunction of some kind.

4.2.6 Hands, shoes, floor, and workbench must be dry. Avoid making measurements under humid, damp, or other environmental conditions that could affect the dielectric withstanding voltage to the test leads or the Instrument.

4.2.7 For maximum safety, do not touch test leads, circuit, the charger, and the Instrument while power is applied to the circuit being measured.

4.2.8 Use extreme caution when making measurements where dangerous composite voltages could be present, such as in an r-f amplifier.

4.2.9 Do not use test leads which differ from those originally furnished with the Instrument.

4.2.10 Do not float the "—" measuring terminal more than 300 volts (DC plus AC peak) with respect to the powerline or earth ground.

4.3 PRELIMINARY NOTES AND CHECKS

NOTE: Prior to operation of the Instrument, review and perform (where applicable) the following notes and checks. These steps can be used also as a general function check.

4.3.1 The 462 is supplied with rechargeable nickel-cadmium batteries that are factory installed. (Charge the batteries overnight before operating the Instrument for the first time.)

CAUTION

Do not operate the Instrument with cells in the completely discharged state.

4.3.2 To recharge the battery, follow these procedures:

a. Set the POWER switch to the OFF position and connect the charger to the 462.

b. Connect the charger into a power outlet which conforms to the power requirements of the Instrument and to the latest electrical code.

c. The battery is being charged at full rate (allow 12 hours for full charge).

4.4 GENERAL FUNCTIONAL CHECK

a. Connect the BLACK test lead to the "—" jack and the RED test lead to the "+" jack. Short the test leads together.

b. Set the $\overline{\text{DC}}$,Ω function switch in the "OUT" position and depress the "kΩ" function and "AUTO" range switches.

c. Separate the test leads. The numerical display will blank in the out-of-range condition. The "MΩ" indicator will also light.

d. Short the test leads together. The display reading will return to .000 ±1 digit.

e. If difficulty is encountered in the above steps, refer to Section 6, Table 6-1.

4.5 DC VOLTAGE MEASUREMENTS

a. Review the Safety Precautions in paragraph 4.2.

b. Connect the red test lead to the "+" jack and the black lead to the "—" jack.

c. Set the "$\overline{\text{DC}}$,Ω" function switch to the "OUT" position.

d. Depress the "V" function switch.

e. Depress the "AUTO" switch. When making repeated measurements on one range, use the appropriate manual switch.

f. Turn off the power to the device or circuit under test and discharge all capacitors.

CAUTION

Do not attempt to measure voltages on the 1000 VDC range which might be greater than 1000 volts DC.

g. Connect test leads to the circuit being measured.

h. Apply power to the circuit being measured. The Instrument will automatically indicate the correct polarity. The value of the voltage being measured will be indicated on the numerical display: "—" to indicate negative and a no sign to imply positive polarity.

i. If the voltage being measured is less than 200mV, depress the "200mV" function switch.

j. Remove all power from the circuit being measured and discharge all capacitors prior to disconnecting test leads.

4.6 AC VOLTAGE MEASUREMENT

a. Review Safety Precautions in Paragraph 4.2.

b. Connect the red test lead to the "+" jack and the black lead to the "—" jack.

c. Depress the "$\tilde{A}C$" and "V" function switches.

d. Depress the "AUTO" switch. When making repeated measurements on one range, use the appropriate manual switch.

CAUTION

Do not attempt to measure voltages on the 600 VAC range which might be greater than 600 volts.

e. Remove all power from the circuit being measured and discharge all capacitors.

f. Connect test leads to the circuit being measured.

g. Apply power to the circuit being measured. The value of the voltage being measured will be indicated on the numerical display.

h. If the voltage being measured is less than 200 mV, depress the "200mV" function switch.

i. Remove all power from the circuit being measured and discharge all capacitors prior to disconnecting test leads.

4.7 RESISTANCE MEASUREMENTS

4.7.1 GENERAL

a. Review the Preliminary Notes and Checks in Paragraph 4.3.

b. Connect the red test lead to the "+" jack and the black lead to the "—" jack.

c. Set the "$\overline{\overline{DC}}$,Ω" function switch to "out" position.

d. Depress the "kΩ" function switch.

e. Depress the "AUTO" switch. When making repeated measurements on one range, use the appropriate manual switch.

f. If the resistance being measured is connected into a circuit, be certain that all power is removed from the circuit and all capacitors are discharged. Check for current paths other than through resistance being

measured. These paths can result in a measured value which is lower than the actual value of the resistance being measured.

g. Connect the test leads to the resistance being measured. Be careful not to contact adjacent points, even if insulated, particularly when making high resistance measurements. Some insulators can have relatively low insulation resistance, which can sufficiently shunt the resistance being measured to result in a measured value lower than the actual value.

h. Allow time for the display to stabilize. This procedure is especially important when measuring a high value resistance shunted by a large value of capacitance. The "MΩ" indicator will light in the 20 MΩ range.

i. Disconnect test leads.

4.7.2 DIODE TEST

a. The forward voltage drop of a diode can be measured at 1mA by using the 2 kΩ range. The diode under test must be out of its circuit. Simply connect the "+" lead to the anode, and the "—" lead to the cathode of the diode. For silicon diodes, the Instrument should display .550 or higher. For germanium diodes, the Instrument should display .450 or lower. The above indications are in volts.

NOTE: The Instrument may display a negative Over-Range indication when it is first turned on in the kΩ position. If this occurs, short the two leads together before making the diode test.

b. When measuring the reverse resistance of a semiconductor junction, the Instrument may display "over-range."

4.8 DC CURRENT MEASUREMENTS

a. Review Safety Precautions in Paragraph 4.2.

b. Connect the red test lead to the "+" jack and the black lead to the "—" jack.

c. Set the "$\overline{\overline{\overline{\text{DC}}}}$,Ω" switch so that it is in the "out" position and depress the "mA" function switch.

d. Depress the appropriate current range switch. If the current being measured is unknown, begin with the 2000 switch. DO NOT USE THE "AUTO" RANGE SWITCH.

e. Remove All Power From the Circuit Being Measured and Discharge All Capacitors.

f. Open the circuit in which the current is to be measured and securely connect the test leads in series.

CAUTION

Ensure that a current range is never connected across a voltage source and that the circuit into which the 462 is connected (in series) does not have a voltage, with respect to ground, exceeding the rated circuit-to-ground voltage of the 462 (refer to Table 1-1, item 6).

g. Apply power to the circuit being measured.

h. The value of the current being measured is indicated on the numerical display.

i. Remove All Power From The Circuit Being Measured and Discharge All Capacitors.

j. Disconnect the test leads and reconnect the circuit which was originally opened.

4.9 AC CURRENT MEASUREMENTS

a. Review Safety Precautions in Paragraph 4.2.

b. Connect the red test lead to the "+" jack and the black lead to the "—" jack.

c. Set the "$\tilde{A}C$" and "mA" function switches.

d. Depress the appropriate current range switch. If the current being measured is unknown, begin with the 2000 switch. DO NOT USE "AUTO" RANGE SWITCH.

e. **Remove All Power From the Circuit Being Measured and Discharge All Capacitors.**

f. Open the circuit in which the current is to be measured and securely connect the test leads in series.

WARNING

Ensure that a current range is never connected across a voltage source and that the circuit into which the 462 is connected (in series) does not have a voltage, with respect to ground, exceeding the rated circuit-to-ground voltage of the 462 (refer to Table 1-1, item 6).

g. Apply power to the circuit being measured.

h. The value of the current being measured is indicated on the numerical display.

i. **Remove All Power From The Circuit Being Measured and Discharge All Capacitors.**

j. Disconnect the test leads and reconnect the circuit which was originally opened.

SECTION V

THEORY OF OPERATION

5.1 OVERALL SYSTEM

5.1.1 The basic system block diagram for the 462 is shown in Figure 5.1.

5.1.2 SIGNAL CONDITIONING SECTION

5.1.3 The parameter being measured is connected to the input terminals. The corresponding Signal Conditioning circuits convert this parameter into a proportional DC voltage. The conversion is accomplished by the Attenuator, Current Shunts, Resistance Converter, AC-to-DC Converter, and associated switching.

5.1.4 ANALOG-TO-DIGITAL CONVERTER SECTION

5.1.5 The Analog-To-Digital (A/D) Converter section changes the DC output voltage from the Signal Conditioning section to digital information. Using a Large-Scale Integration (LSI) circuit, the unique A/D converter automatically eliminates zero error.

5.1.6 AUTO RANGING SECTION

5.1.7 The auto ranging logic gets its commands from the A/D LSI. These commands tell the control logic when to switch the input dividers and in what direction.

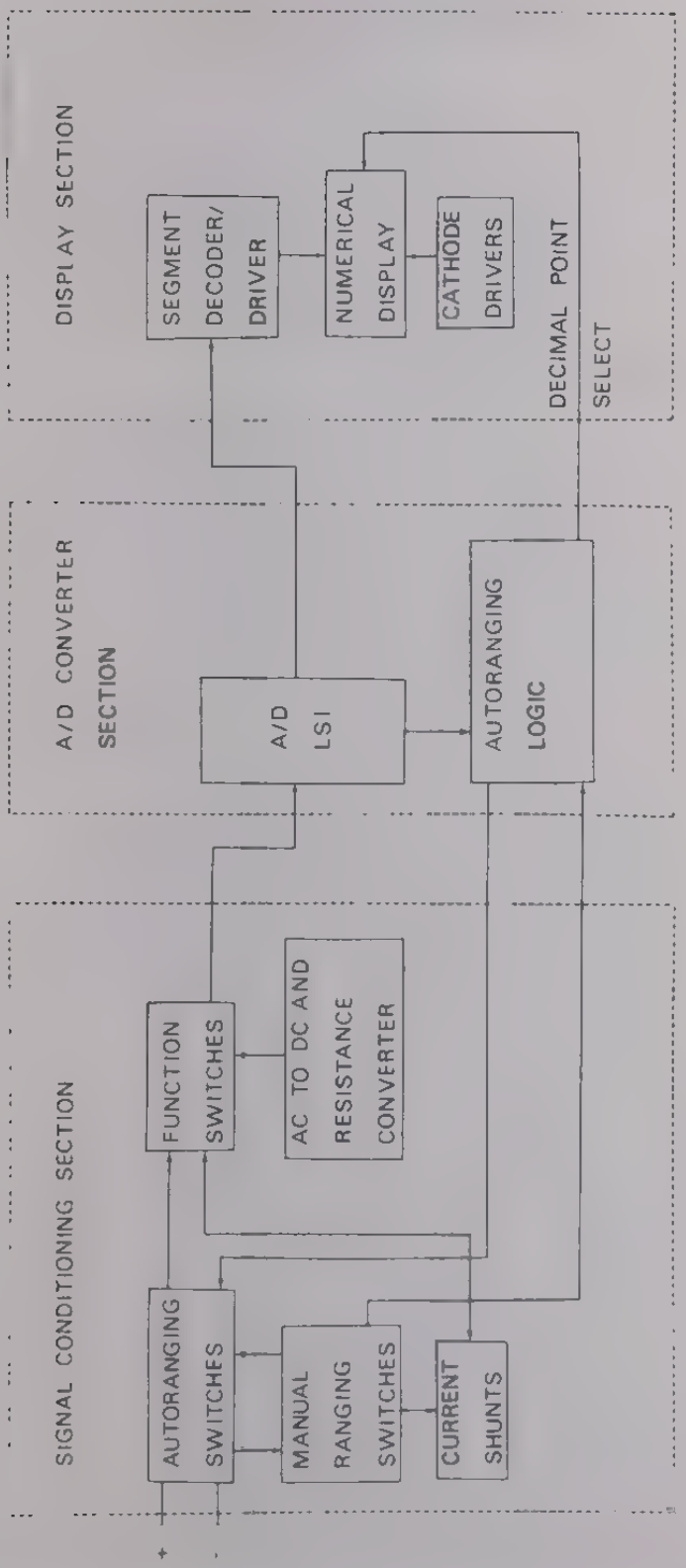


Figure 5-1. Basic System Block Diagram

5.1.8 DISPLAY SECTION

5.1.9 Digital information in BCD form from the A/D Converter section is decoded into 7-segment information by the Decoder/Driver. The decoded information, in conjunction with the Cathode Drivers, is visually presented on the Numerical Display.

5.2 INPUT CIRCUITS

5.2.1 DC VOLTAGE MEASUREMENTS

5.2.2 The basic DC voltage circuit is shown in Figure 5-2(A). The DC voltage being measured is connected to the "+" and "—" jacks, attenuated according to the range selected and converted into digital information by the A/D Converter.

5.2.3 The A/D Converter circuit provides two basic full range sensitivities: 200mV and 2V. No attenuation is required on the 200mV and 2V ranges. The attenuator is used on the 20V, 200V, and 1000 Volt Ranges.

5.2.4 AC VOLTAGE MEASUREMENT

5.2.5 The basic AC voltage measurement circuit is shown in Figure 5-2(B). The AC voltage being measured is connected to the "+" and "—" jacks, attenuated according to the range selected and applied to the amplifier. The output of the amplifier is converted into DC voltage by an active rectifier and the resulting DC voltage is measured by the A/D Converter.

5.2.6 The AC-DC Converter provides two basic full range sensitivities: 200mV and 2V. The converter is average responding but its calibration (gain) is based on the rms value of a sine wave.

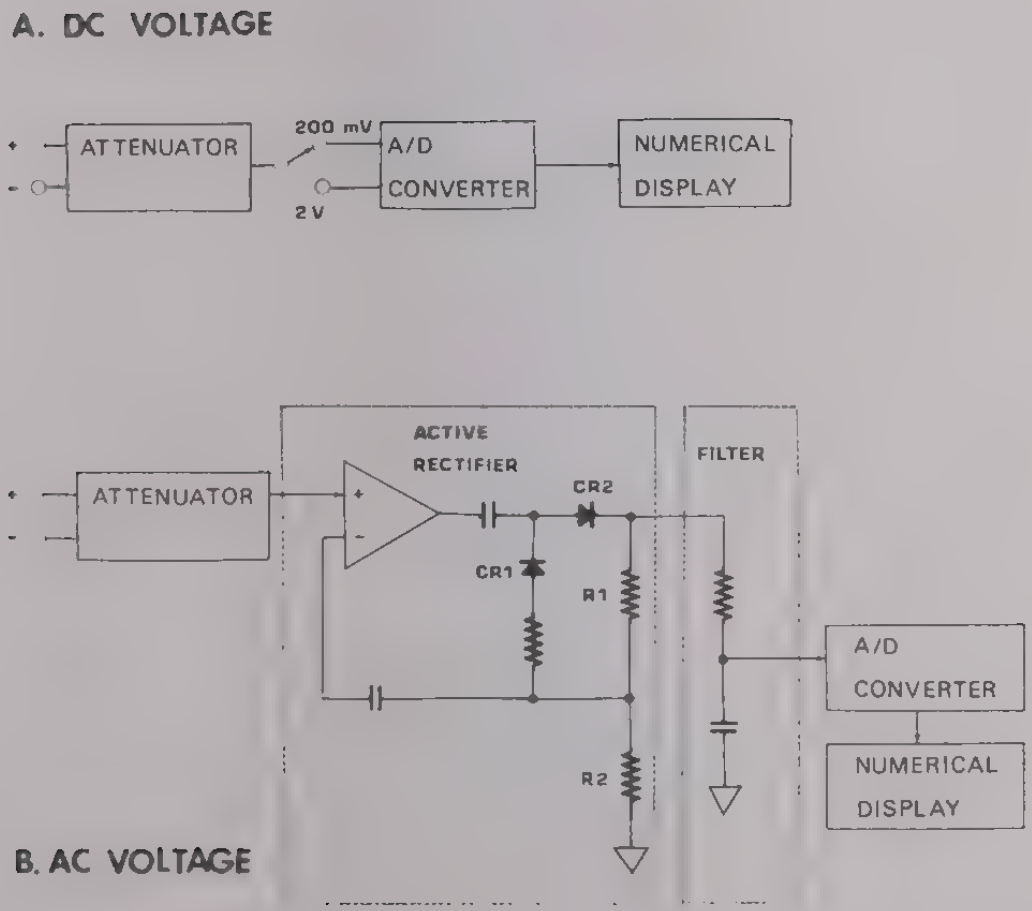


Figure 5-2. Basic Voltage Measurement Circuits

5.2.7 The AC-DC Converter consists of a precision half-wave active rectifier and is applied to the non-inverting input of the operational amplifier. Negative feedback causes the voltage at the inverting input to follow the non-inverting input, causing a current Ein/R2, through R2 to circuit common. Since diodes CR1 and CR2 conduct on alternate half cycles, one-half of the average current flows through R1. The rectified voltage developed across R1 is filtered by the RC filter to produce the DC voltage required for the A/D Converter.

5.2.8 DC CURRENT MEASUREMENTS

5.2.9 The basic DC current measurement circuit is shown in Figure 5-3(A). The current being measured is connected in series with the "+" and "—" jacks across an internal precision shunt resistance. The value of the shunt resistance depends on the current range selected. The DC voltage developed across the shunt resistor is measured by the A/D Converter.

5.2.10 The full range sensitivity of the A/D Converter is set for 200mV. The internal shunt resistance for each current equals 200mV divided by the full range current. For example, if the full range current is 2mA, the shunt resistance is 100 ohms.

5.2.11 AC CURRENT MEASUREMENTS

5.2.12 The basic AC current measurement circuit is essentially the same as the DC current measurement circuit (paragraph 5.2.8), except that the voltage developed across the internal shunt resistance is measured by the AC voltage measurement circuit.

5.2.13 RESISTANCE MEASUREMENTS

5.2.14 The basic resistance circuit is shown in Figure 5-3(B). The resistance being measured, Rx, is connected to the "+" and "—" jacks and a constant current is applied through it by the Instrument. The resulting voltage is proportional to the value of Rx.

5.2.15 The operational amplifier bootstraps the constant current source. With the non-inverting input connected to the junction of Ra and Rx such that a constant voltage is maintained across Ra for a given range. The voltage developed is proportional to the value of Rx.

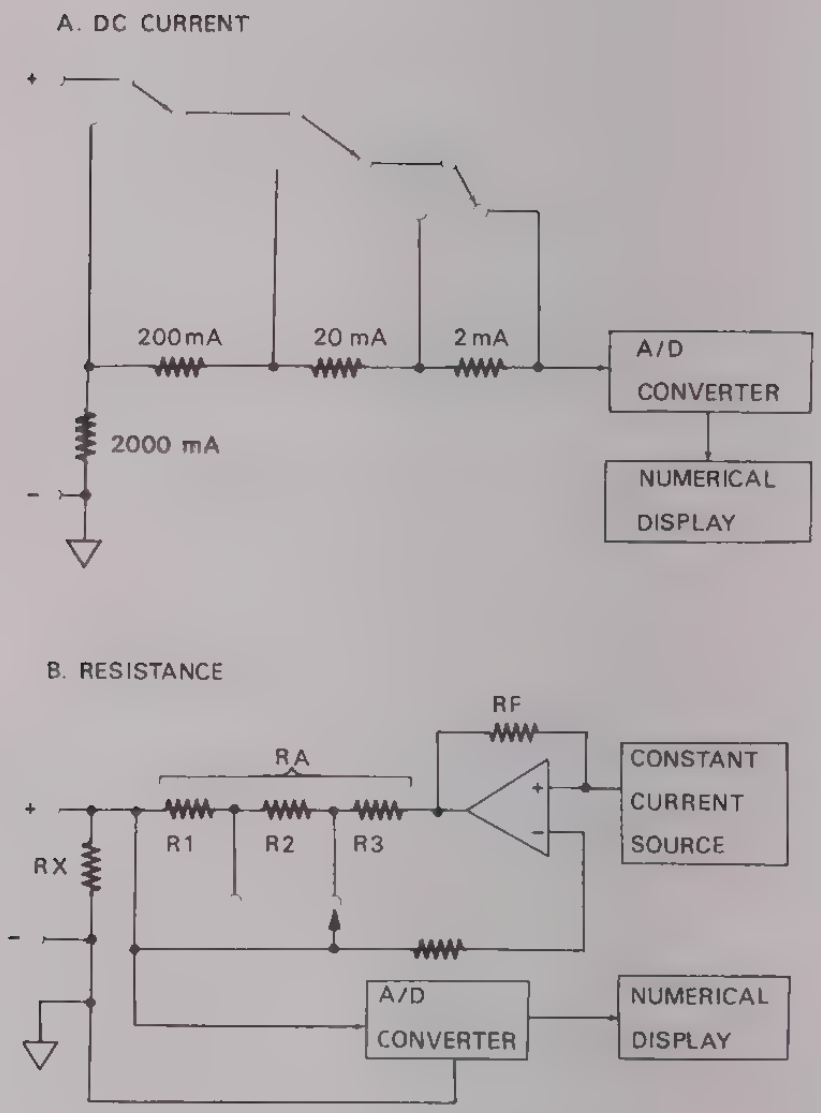


Figure 5-3. Basic DC Current and Resistance Measurement Circuits

WARNING

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

SECTION VI

SERVICING INSTRUCTIONS

6.1 GENERAL

6.1.1 The 462 is carefully designed and constructed with high quality components. By providing reasonable care and following the instructions in this manual, the user can expect a long, useful service life from his Instrument.

6.2 COVER REMOVAL

6.2.1 The rear cover can be removed for maintenance purposes by the following procedures.

WARNING

Remove all power and connections to the Instrument before removing the case cover. Do not operate the Instrument with the rear cover removed.

a. Set the POWER switch to the OFF position.

b. Disconnect the charger and the test leads from the Instrument.

c. Turn the two screws on the back cover counterclockwise until the rear cover is removed. (The two screws will remain in the cover.)

d. Reverse this procedure when replacing the cover.

6.3 BATTERY INSTALLATION

6.3.1 Only use the rechargeable nickel-cadmium batteries supplied with this Instrument. In an emergency, "AA" size rechargeable nickel-cadmium cells (rated 1.25V 0.5 ampere-hour) can be considered as a replacement. However, continuous operation of the 462 will reduce the operating time of these cells to 6 hours.

CAUTION

To avoid dangers associated with recharging batteries, use only the type specified. Do not attempt to use cadmium zinc, alkaline or the like that is not designed to be recharged.

6.3.2 Replace the Cells As Follows:

a. Remove rear cover (paragraph 6.2). Remove the old batteries with the retainer tubings from the battery holder. Insert two new cells into each retainer. Then install the combination into the holder.

CAUTION

Ensure that the cells are installed according to the polariity orientation designated on the battery holder label. Failure to do so can damage the 462.

b. Check that the battery contacts are clean and making good connection.

c. Replace the rear cover.

d. For battery recharging, refer to paragraph 6.4.

6.4 BATTERY CHARGING

WARNING

To avoid dangers associated with recharging batteries use only Nickel-Cadmium type batteries as specified.

6.4.1. The battery is being charged at full rate when the POWER switch is set to the OFF position and AC power is applied to the charger. Approximately 12 hours are required to fully charge the battery in this mode of operation.

6.5 BATTERY CARE

6.5.1 Avoid discharging the cells completely.

6.5.2 Do not operate the Instrument with discharged cells. **Make sure to recharge all newly purchased batteries (paragraph 6.4.1) for at least 12 hours before operating the Instrument.**

6.5.3 Whenever the charger is not connected and the Instrument is not in use, remember to set the POWER switch to the OFF position.

6.6 FUSE REPLACEMENT

6.6.1 The current fuse is mounted inside on the Battery Board as shown in Figure 6.1. Use the following procedure to replace a fuse.

WARNING

Remove all power and input connections to the Instrument before removing rear cover.

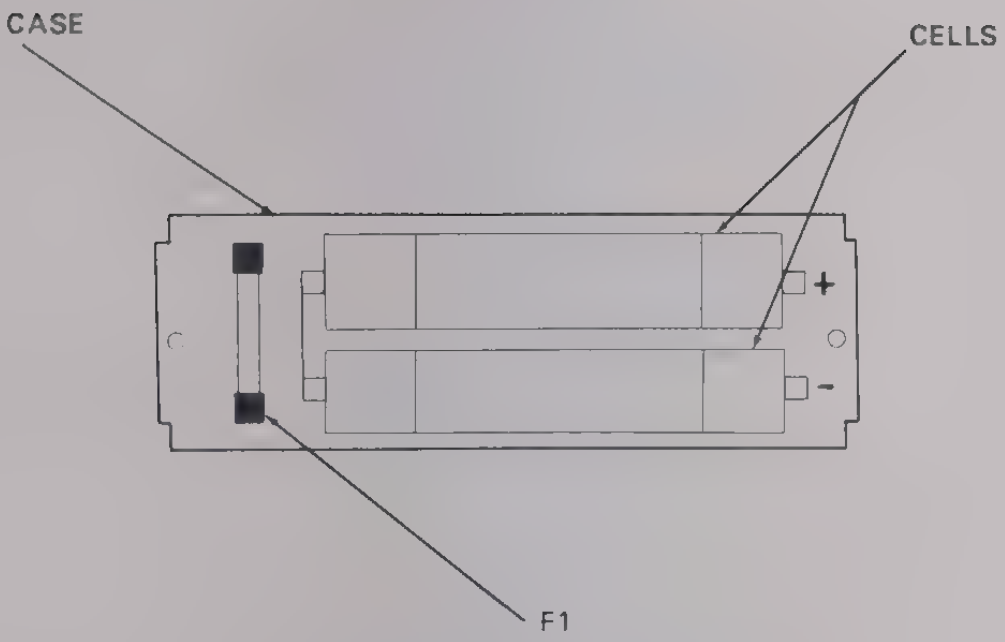


Figure 6-1. Model 462, Fuse Location

6.6.2 Remove rear cover as described in paragraph 6.2.

WARNING

Do NOT replace a blown fuse with a fuse that has a larger rating or slower time lag characteristic than those specified.

6.6.3 Carefully lift the defective fuse from the holder and replace with appropriate fuse (Table 7-1).

6.6.4 Replace the rear cover.

6.6.5 If the current ranges are still inoperative, it may be possible that the F2 is blown. If this is the case, a large amount of energy has been applied to the current range. (F2 is inside the unit and can be replaced by ordering a duplicate at an authorized service center.)

6.7 TROUBLESHOOTING

6.7.1 If the Instrument does not yield satisfactory results, follow this procedure before attempting maintenance on the Instrument.

a. Review and comply with the Preliminary Notes and Checks, listed in paragraph 4.3.

b. Check that all switches are positioned correctly for the parameter and range of value being measured and that the measurement situation is within the ratings of the Instrument.

c. Be sure that the cells are charged and properly installed (paragraph 6.3).

d. If the 462 has been operated with a charger, ensure that power source is within the Instrument specifications, and free from excessive fluctuation and transients.

e. Ensure that the environment in which the Instrument is being used is within the Instrument specifications.

f. Inspect the device being measured and the measurement test set-up to ensure that proper shielding and grounding techniques have been used. Also, consider whether the Instrument is significantly affecting the circuit being measured.

6.7.2 If the steps taken in paragraph 6.7.1 do not yield satisfaction, refer to the troubleshooting chart (Table 6-1). Direct all other repair and adjustment needs to an Authorized Service Center. A list of these centers appears at the back of this manual.

Table 6-1. Troubleshooting Chart

Symptom

1. LOW intensity on numerical display in battery operation.

Probable Causes

Cells not fully charged.

Cure

Recharge batteries overnight.

Symptom

2. Batteries do not respond to charge. Read-out is dim when charger is used.

Probable Causes

Cells defective, not installed properly, making poor contact, or missing.

Cure

Remove cover and check that cells are installed correctly and making good contact.

Symptom

3. Indication fluctuates under all conditions.

Probable Causes

Batteries not making contact, or Instrument is without batteries.

Troubleshooting Chart (Con't)

Cure
Locate the defective contact or install a new set of batteries.

Symptom

4. Indications fluctuate and/or drift, even though input terminals shorted, and at 1000 counts when using a stable and low impedance input.

Probable Causes
Fluctuations and/or drift are being generated by the device being measured or the measurement test set up.

Cure
Use proper shielding, grounding techniques and connections to minimize "pick-up" of unwanted signals due to ground loops, poor connections, and capacitive and/or inductive coupling.

Symptom

5. Slow response. Operation OK when using a low impedance input.

Probable Causes
Parameter being measured has a high source impedance.

Cure
None required.

Symptom

6. Accuracy not within specifications when checked with a stable, higher accuracy (at least 5 times better) low impedance (voltage measurements) source.

Probable Causes
Instrument is out of calibration.

Troubleshooting Chart (Con't)

Cure
Contact nearest Authorized Service Center.

Symptom
7. Accuracy of Instrument is within specifications but measurement appear in error.

Probable Causes
a. Instrument affects circuit being measured.
b. Common and/or normal mode specifications is being exceeded.

Cure
a. Study circuit being measured vs. Instrument specifications. Correct indications accordingly.
b. Refer to cure in item 4 above.

Symptom
8. Operation normal on all functions and ranges except AC and DC Current.

Probable Causes
Current fuse F1 open.

Cure
Replace fuse F1. Refer to paragraph 6.6.

Symptom
9. Operation normal on all functions and ranges except AC and DC Current (F1 checks OK).

Probable Causes
Current fuse F2 open.

Cure
If F2 has been blown, a large amount of energy has been applied to the current ranges. This measurement condition must be corrected. (Refer to paragraph 6.6.5).

6.8 Replacement Parts and Schematic Diagram

6.8.1 Table 6-2 lists parts in alphanumeric order of their reference designators and indicates the description. (Refer to Table 1-2 for items and accessories furnished with this Instrument.)

6.8.2 To obtain replacement parts, address orders to the nearest Authorized Service Center (listed on the last pages of this manual). Refer to paragraph 2.3.1 for ordering instructions.

Table 6-2. Replacement Parts

Symbol	Description	Part No.
C101	Capacitor, .02μF, 600V	1-117367
C102	Capacitor, .047μF, 630V, ±20%	5-119945
C103, C105	Capacitor, Trimmer, 5-50 pF	6-110125
C104	Capacitor, 887 pF, ±2%, 250V	6-110820
C106	Capacitor, .01μF ±10%, 250V	6-110819
C107	Capacitor, 6.8 pF, 1kV ±5%	5-110057
C108	Capacitor, 2500 pF, 1kV	5-113985
C109	Capacitor, 100 μf, 10V	5-117206
D101, D102	Diode, IN914	5-112004
D103, D104		
D105, D106		
ZD101	Diode, IN4570	5-119942
IC101	I.C. Quad Switch, Selected, CD 4066	6-110915
R101	Resistor, 100kΩ, ±5%, ½W	5-118625
R102	Resistor, 220kΩ, ±10%, 2W	6-110653
R103	Resistor, 10 Meg ohm, ±.1%, 3/4W	6-110651

Table 6-2 (Con't)

Symbol	Description	Part No.
R104	Resistor, 100 Meg ohm, ±10%, 1W	6-110652
R105	Resistor, 1.11 Meg ohm, ±.1%, ¼W	6-110650
R106, R114 R116	Potentiometer, 1kΩ	6-110472
R107	Resistor, 100kΩ, ±1%, ½W	6-110649
R108	Potentiometer, 500Ω	6-110701
R109	Resistor, 9.64kΩ, ±.1%, 2W	6-110648
R110	Resistor, 1.0kΩ, ±1%, 2W	5-119936
R111	Resistor, 10kΩ, ±5%, ¼W	5-118161
R112	Resistor, 100kΩ, ±5%, ¼W	5-118168
R113	Resistor, 1kΩ, ±5%, 3W	5-119931
R115	Resistor, 11.0kΩ, ±1%, ¼W	5-118760
R117	Resistor, 3620Ω, ±1%, ¼W	6-110062
R118	Potentiometer, 250Ω	6-110471
R119	Resistor, 372Ω, ±1%, ¼W	5-118052
R120	Potentiometer, 100Ω	6-110450
R121	Resistor, 487Ω, ±1%, ¼W	5-117466
R122	Resistor, 2490Ω, ±1%, ¼W	5-117270
R123	Resistor, 20Ω, ±5%, 1W	6-110123
Q101	Transistor, PNP, MPS3702	5-113864
	Switch, Pushbutton, Function	6-110624
C201, C203, C206	Capacitor, 15μF, 16V	5-115534
C202	Capacitor, 100pF, 1kV	5-113217
C204, C205	Capacitor, .47μF, 16V	5-118564
D201	Diode, IN914	5-112004
D202	Diode, MS8211	5-115784
IC201	I.C. Op. Amp., LF356N	6-110628
IC202	I.C. Op. Amp., LM741	5-115928
Q201, Q202	Transistor, Silicon, 2N4123	5-115931

Table 6-2 (Con't)

Symbol	Description	Part No.
R201	Resistor, 330kΩ, ¼W, 5%	5-115965
R202	Resistor, 7.44kΩ, ±1%, ¼W	5-119937
R203, R204	Resistor, 4.99kΩ, ±1%, ¼W	5-115502
R205, R206	Resistor, 49.9kΩ, ±1%, ¼W	5-115525
R207	Resistor, 1MΩ, ±5%, ¼W	5-118648
R208	Resistor, 100Ω, ±5%, ¼W	5-118152
R209, R210	Resistor, 2kΩ, ±1%, ¼W	5-115500
R211	Resistor, 470kΩ, ±5%, ¼W	5-118169
R212	Resistor, 4.08kΩ, ±.25%, ¼W	5-118412
R213	Resistor, 448Ω, ±.25%, ¼W	5-118411
C301	Capacitor, .01μF	5-113184
C302	Capacitor, .001μF	5-111119
C303	Capacitor, 100μF, 10V	5-117050
C304	Capacitor, 100μF, 10V	5-117206
C305	Capacitor, 10μF, 16V	5-117205
C306, C307	Capacitor, .1μF, 100V	5-113612
C308, C309	Capacitor, 100pF	5-113217
C310	Capacitor, .033μF, 100V	5-117732
C311	Capacitor, 1μF, 35V	5-116713
D301, D302	Diode, Silicon, IN5059	5-113826
D303-D314	Diode, Silicon, IN914	5-112004
ZD301	Diode, Zener, IN4738A	6-110002
IC301	I.C. Quad Switch, CD4066	6-110627
IC302	I.C. CMOS Shift Register, 74C95	6-110626
IC303	I.C. CMOS GATE, 74C20	5-118311
IC304	I.C. CMOS GATE, 74C74	5-118312
IC305	I.C. Voltage Converter, AA4380	5-119925
IC306	I.C. Motorola A/D, MC14433P	5-119926
IC307	I.C. Hex Driver, 75492P	5-119928
	Switch, Pushbutton, Range	6-110623

Table 6-2 (Con't)

Symbol	Description	Part No.
Q301-Q307	Transistor, PNP, MPS3702	5-113864
Q308, Q309	Transistor, NPN, 2N4123	5-115931
Q310	Transistor, FET, 2N4302	6-110059
R301	Resistor, 90.0Ω, ±.25%	5-116272
R302	Resistor, 9.0Ω, ±25%	5-118410
R303	Resistor, 0.897Ω, ±.25%	5-118409
R304	Lead, 3½" LG	3-812505
R305-R313, R316-R319, R338, R339	Resistor, 100kΩ, ±5%, ¼W	5-118168
R314, R320-R323, R328-R331, R340	Resistor, 10kΩ, ±5%, ¼W	5-118161
R315	Resistor, 2.2 Megohms	5-118308
R324-R327	Resistor, 100Ω, ±5%, ¼W	5-118152
R332	Resistor, 4.7kΩ, ±5%, ¼W	5-118160
R333, R336 R337	Resistor, 470kΩ, ±5%, ¼W	5-116631
R334	Resistor, 220kΩ, ±5%, ¼W	5-119707
R335	Resistor, 27kΩ, ±5%, ¼W	5-118164
D401	Diode, Light Emitting	5-117431
DS401	LED, ±1	5-119944
DS402-DS404	LED, 7 segment	5-119943
IC401	I.C. Decoder-Driver, MC14511P	5-119927
R401-R408	Resistor, 100Ω, ±5%, ¼W	5-118152
R409	Resistor, 100kΩ, ±5%, ¼W	5-118168

AUTHORIZED SERVICE CENTERS
SIMPSON ELECTRIC COMPANY

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3028 Seventh Avenue, South
Tel. 205/323-4761

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3258 Springhill Avenue
Tel. 205/478-3230

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3450 Armour Drive
Tel 205/479-8581

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METERMASTER, INC.
4134 E. Wood Street, Suite 260
Tel. 602/437-1425

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METER CRAFT
17951 Sky Park Drive, Suite "F"
Tel. 714/261-7135

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Tel. 213/685-4340

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Tel. 415/968-0313

★★★ **CALIFORNIA, SAN DIEGO 92123**
METERMASTER/SAN DIEGO
8799 Balboa Avenue
Tel. 619/560-4841

★★★ **CALIFORNIA, SAN FRANCISCO 94105**
PACIFIC ELECTRICAL INSTRUMENT LAB.
150 Folsom St.
Tel. 415/543-3104

★★★ **CALIFORNIA, SANTA CLARA 95050**
DYNAMETRON
2000 De La Cruz Blvd.
Tel. 408/727-6531

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ETALON COMPANY
1323 Huntington Drive
Tel 818/257-5410

★★ **CALIFORNIA, WILMINGTON 90744**
W LMINGTON INSTRUMENT CO
332 N Fries Avenue
Tel. 213/834-1133

★★★ **COLORADO, AURORA 80010**
R & R INSTRUMENTATION INC
1554 Elmira St.
Tel 303/364-8325

★★★ **COLORADO, DENVER 80219**
METER MASTER INSTRUMENT CORP
2630 W 2nd Avenue
Tel 303/722-5766

★★★ **CONNECTICUT, HAMDEN 06514**
KAUFMAN INSTRUMENT LABS INC
Chimney Square, Suite 1A
1125 Dixwell Ave.
Tel. 203/776-7201

★★★ **CONNECTICUT, MIDDLETOWN 06457**
E. I. L. INSTRUMENTS, INC.
125 Coe Avenue
Tel. 203/346-6646

★★★ **FLORIDA, HIALEAH 33014**
KIMBALL ELECTRONIC LAB , INC
8081 W 21st Lane
Tel. 305/822-5792

★★ **FLORIDA, MIAMI 33136**
FLORIDA PRECISION INSTRUMENT CORP
800 N. W. 7th Avenue
Tel. 305/324-1731

★★★ **FLORIDA, MIAMI 33166**
BROWNELL INSTRUMENTS & CONTROLS CO
6850 N.W 74th Street
Tel 305/884-3072

★★★ **FLORIDA, ORLANDO 32806**
BROWNELL INSTRUMENTS & CONTROLS CO
307 27th St. - Box 8945
Tel. 305/843-6770

★★★ **FLORIDA, PALM BAY 32907**
E. I. L. INSTRUMENTS, INC
1914 Canova St., S.E.
Tel. 305/725-8300

★★★ **FLORIDA, TAMPA 33614**
BROWNELL INSTRUMENTS & CONTROLS CO.
5518 Pioneer Park Blvd
Tel. 813/885-6002

★★★ **GEORGIA, ATLANTA 30336**
PROCESS MEASUREMENT CO.
4509 Futon Industrial Blvd.
Tel. 404/696-7334

★★★ **GEORGIA, ATLANTA 30354**
BROWNELL INSTRUMENTS & CONTROLS CO.
3020 Commerce Way
Tel. 404/762-5181

★★★ **ILLINOIS, BRIDGEVIEW 60455**
E. I. L. INSTRUMENTS, INC
9708 Industrial Drive
Tel. 312/430-2292

5/85

★★★ **ILLINOIS, CHICAGO 60617**
W. H. LEARY CO., INC.
8320 Stoney Island Avenue
Tel 312/721-3832

★★★ **ILLINOIS, COUNTRYSIDE 60525**
☐ PACIFIC INDICATOR COMPANY
5320 East Avenue
Tel 312/352 3500

★★★ **ILLINOIS, ITASCA 60143**
☐ METERMASTER, INC.
1100 W Thorndale Rd
Tel 312/250-0606

★★★ **INDIANA, EVANSVILLE**
☐ ELECTRO-LAB SERVICES INC.
1302 N. Fulton 47710 (UPS)
P O Box 6301 47712 (Mail)
Tel 812/423-5211

★★★ **INDIANA, INDIANAPOLIS 46226**
☐ E I L INSTRUMENTS, INC.
7061 Twin Oaks Dr. "M"
Tel. 317/545-1373

★★ **KANSAS, OVERLAND PARK 66206**
BROOKS ELECTRONICS INC.
10418 Metcalf
Tel 913/648-3131

★★★ **KANSAS, WICHITA 67213**
☐ THE METER SHOP
1650-6 S Meridian
Tel 316/945-8866

★★★ **LOUISIANA, NEW ORLEANS 70123**
☐ INDUSTRIAL INSTRUMENT WORKS
5745 Salmen Ave
Tel 504/733-8355

★★★ **MARYLAND, GAITHERSBURG 20877**
☐ PIONEER-STANDARD ELECTRONICS
Instrumentation Division
9100 Gaither Road
Tel 301/921-0660

★★★ **MARYLAND, SAVAGE 20863**
PYTTRONIC INDUSTRIES, INC.
8220 Wellmoor Court
Tel 301/792-0780

★★★ **MARYLAND, SPARKS 21152**
☐ E. I. L. INSTRUMENTS, INC.
10 Loveton Circle
Tel 301/771-4800

★★★ **MASSACHUSETTS, BURLINGTON 01803**
☐ E. I. L. INSTRUMENTS, INC
21 "A" Street
Tel 617/272-9450

★★★ **MASSACHUSETTS, WOBURN 01801**
BROWNELL INSTRUMENTS & CONTROL CO
10 Linscott Road
Tel 617/935-7820

★★★ **MICHIGAN, FERNDALE 48220**
☐ RAM METER INC
1100 Hilton Road
Tel 313/398-6767

★★★ **MINNESOTA, MINNEAPOLIS 55427**
☐ INSTRUMENTATION SERVICES, INC.
957 Winnetka Avenue North
Tel 612/544-8916

★★ **MISSISSIPPI, PASCAGOULA 39567**
INSTRUMENT REPAIR SERVICE OF MISSISSIPPI
1405 Live Oak Avenue
P O Box 1243
Tel 601/769-2421

★★★ **MISSOURI, ST. LOUIS 63136**
C & S INSTRUMENTS
5749 Helen Avenue
Tel 314/383-4445

★★★ **MISSOURI, ST. LOUIS 63108-2699**
(S & S INDUSTRIAL SERVICE LABS) CORP
4354 Olive Street
Tel 314/535-5760
Outside Missouri 1-800/325-8653

★★★ **MISSOURI, ST. LOUIS 63143**
☐ SCHERRER INSTRUMENTS INC.
7170 Manchester Ave.
Tel 314/644-5362

★★★ **MONTANA, BILLINGS 50101**
INDUSTRIAL ELECTRONICS
201 Erie
Tel 406/259-1212

★★★ **NEBRASKA, LINCOLN 68507**
☐ ELECTROMETRICS COMPANY
6433 Havelock
Tel. 402/467-3541

★★★ **NEW JERSEY, BELLEVILLE 07109**
MISCORP
236 Washington Avenue
Tel. 201/751-1190

★★★ **NEW JERSEY, EDISON 08817**
☐ BROWNELL INSTRUMENTS & CONTROLS CO.
84 Executive Ave.
Tel 201/287-2030

★★★ **NEW JERSEY, NEWFOUNDLAND 07435**
☐ HOSICA LABORATORIES
715 Route 23S
Tel. 201/697-7542

★★★ **NEW JERSEY, PENNSAUKEN 08109**
☐ E. I. L. INSTRUMENTS, INC.
7870 Airport Highway
Tel. 609/488-0474

★★★ **NEW MEXICO, ALBUQUERQUE 87102**
☐ INSTRUMENT SERVICE LABORATORIES
630 Haines Avenue NW
Tel 505/842-1107

★★★ **NEW YORK, BALDWIN 11510**
☐ MEASUREMENT DEVICES, INC.
834 Merrick Road
Tel 516/546-2777 or 546-5392

★★★ **NEW YORK, CHADWICKS 13319**
☐ UTICA/CENTRAL NY MOHAWK LTD.
3500 Bleachery Place
Tel. 315/737-7328

★★★ **NEW YORK, CLARENCE 14031**
☐ TROTT ELECTRONICS INC.
9020 Wehrle Drive
Tel. 716/634-8500

★★★ **NEW YORK, HAUPPAUGE 11787**
☐ E. I. L. INSTRUMENTS. INC
180 Oser Avenue
Tel. 516/231-6333

★★★ **NEW YORK, NEW YORK 10011-5287**
☐ NILSSON ELECTRICAL LABORATORY, INC.
111 8th Avenue - Rm. 1525
Tel 212/675-7944

★★★ **NEW YORK, ROCHESTER 14621**
☐ EIC ELECTRONICS INC
85 Avenue E
Tel. 716/544-4392

★★★ **NEW YORK, ROCHESTER 14623**
☐ E. I. L. INSTRUMENTS INC.
3000 Winton Rd., Bldg C
Tel 716/427-8000

★★★ **NORTH CAROLINA, CHARLOTTE 28206**
☐ BROWNELL INSTRUMENTS & CONTROLS CO.
3201 Woodpark Blvd.
Tel. 704/597-1270

★★★ **NORTH CAROLINA, RALEIGH 27604**
☐ BROWNELL INSTRUMENTS & CONTROLS CO.
5245 N Boulevard
Tel. 919/876-6524

★★★ **NORTH CAROLINA, WINSTON-SALEM 27106**
☐ METER METRICS
Div. of Fidus Instrument Corp.
4407 Providence Lane, Suite E
University Commercial Center
Tel 919/722-1624

★★★ **OHIO, CLEVELAND 44105**
PIONEER-STANDARD ELECTRONICS
Instrumentation Division
4800 East 131st Street
Tel 216/587-3600

★★★ **OHIO, CLEVELAND 44136**
WESCHLER ELECTRIC CORP
16900 Foltz Parkway
Tel. 216/238-2550

★★★ **OHIO, DAYTON 45459**
E. I. L. INSTRUMENTS INC.
96A Westpark Drive
Te. 513/435-2134

★★★ **OHIO, DAYTON 45424**
PIONEER-STANDARD ELECTRON CS
Instrumentation Division
4433 Interpoint Blvd
Tel 513/236-9900

★★★ **OKLAHOMA, OKLAHOMA CITY 73107**
HUSTON-DEPUE LABORATORIES INC
536 N. Pennsylvania St
Te.. 405/235-5469

★★ **OKLAHOMA, TULSA 74120**
AGRA ENGINEERING COMPANY
551 S. Quaker Avenue
Tel. 918/584-4235

★★★ **OREGON, PORTLAND 97217**
WESTCON, INC
5101 N Interstate Ave
Tel. 503/283-0132

★★★ **PENNSYLVANIA, PHILADELPHIA 19115**
SUNSHINE SCIENTIFIC INSTRUMENTS INC
1810 Grant Avenue
Tel 215/673-5600

★★★ **PENNSYLVANIA, PITTSBURGH 15238**
C.A.M. INSTRUMENTATION
620 Alpha Drive
Tel. 412/963-1885

★★★ **PENNSYLVANIA, PITTSBURGH 15221**
E. I. L. INSTRUMENTS, INC
1844 Ardmore Blvd
Tel 412/731-5230

★★★ **PUERTO RICO, RIO PIEDRAS 00927**
B&C CALIBRATION
1113-17th St.
Villa Nevarez
Tel. 809/765-2788, 751-8375

★★★ **SOUTH CAROLINA, COLUMBIA 29210**
BROWNELL INSTRUMENTS & CONTROLS CO.
1319 St. Andrews Road
Tel. 803/772-6111

★★★ **TENNESSEE, KNOXVILLE 37922**
BROWNELL INSTRUMENTS & CONTROLS CO
207 Center Park Dr
Tel. 615/966-3441

★★★ **TENNESSEE, MEMPHIS 38118**
BROWNELL INSTRUMENTS & CONTROLS CO.
3821 Getwell Road
Tel. 901/795-8487

★★★ **TENNESSEE, MEMPHIS 38104**
INSTRUMENT REPAIR SERVICE
419 N. Watkins St.
Tel. 901/278-0762

★★★ **TENNESSEE, NASHVILLE 37210**
BROWNELL INSTRUMENTS & CONTROLS CO
1837 Air Lane Drive
Tel. 615/889-8230

★★★ **TEXAS, DALLAS 75248**
E. I. L. INSTRUMENTS, INC
4392 Sunbelt Drive
Tel 214/931-1236

★★★ **TEXAS, DALLAS 75229**
ULTRA INSTRUMENT LAB., INC.
10031 Monroe, Suite 101
Tel. 214/357-0297

★★ **TEXAS, GARLAND 75041**
METERMASTER, INC
2809 National Drive
Tel. 214/271-5671

★★★ **TEXAS, HOUSTON 77081**
E. I. L. INSTRUMENTS, INC.
7385 Ashcroft Street
Tel. 713/271-3100

★★★ **TEXAS, HOUSTON 77023**
METERS & INSTRUMENTS CORP
6428 Gulf Freeway
Tel. 713/644-1631

★★★ **TEXAS, HOUSTON 77004**
QUALITY INSTRUMENT LAB INC
4832 Caroline
Tel. 713/524-0528

★★★ **TEXAS, ODESSA 79760**
WHITLOCK INSTRUMENT
1306 North Texas
Tel. 915/337-3412

★★★ **UTAH, SALT LAKE CITY 84115**
METER MASTER INSTRUMENT CORP
2949 South State Street
Tel. 801/486-4343

★★★ **VIRGINIA, SPRINGFIELD 22153**
E. I. L. INSTRUMENTS, INC.
7643 Fullerton
Te . 703/569-2611

★★★ **VIRGINIA, RICHMOND 23234**
METER METRICS
Div. of Fidus Instrument Corp.
7400 White Pine Road
Tel 804/275-1431

★★★ **VIRGINIA, VIRGINIA BEACH 23462**
E. I. L. INSTRUMENTS, INC.
5801-A Arrowhead Dr.
Te.. 804/499-3746

★★★ **WASHINGTON, SEATTLE 98188**
E. I. L. INSTRUMENTS, INC.
910 Industry Drive
Tel. 206/575-1888

★★★ **WASHINGTON, SEATTLE 98105**
EICHER-RICHARDS COMPANY
2727 N. E. Blakeley Street
P.O. Box 85719
Tel. (Seattle) 206/523-7888
(Portland) 503/221-1123

★★ **WASHINGTON, SPOKANE 99220**
BLACKS-INDUSTRIAL INC
N. 401 Helena - Box 3286
Tel. 509/534-9353

★★★ **WISCONSIN, MILWAUKEE 53202**
E-M INSTRUMENTS INC.
153 No. Milwaukee Street
Tel. 414/272-7799

★★ **WYOMING, LANDER 82520**
METER SPECIALISTS, INC.
P. O. Box 595 (Mail)
Hiway 287 West (UPS)
Tel. 307/332-9711

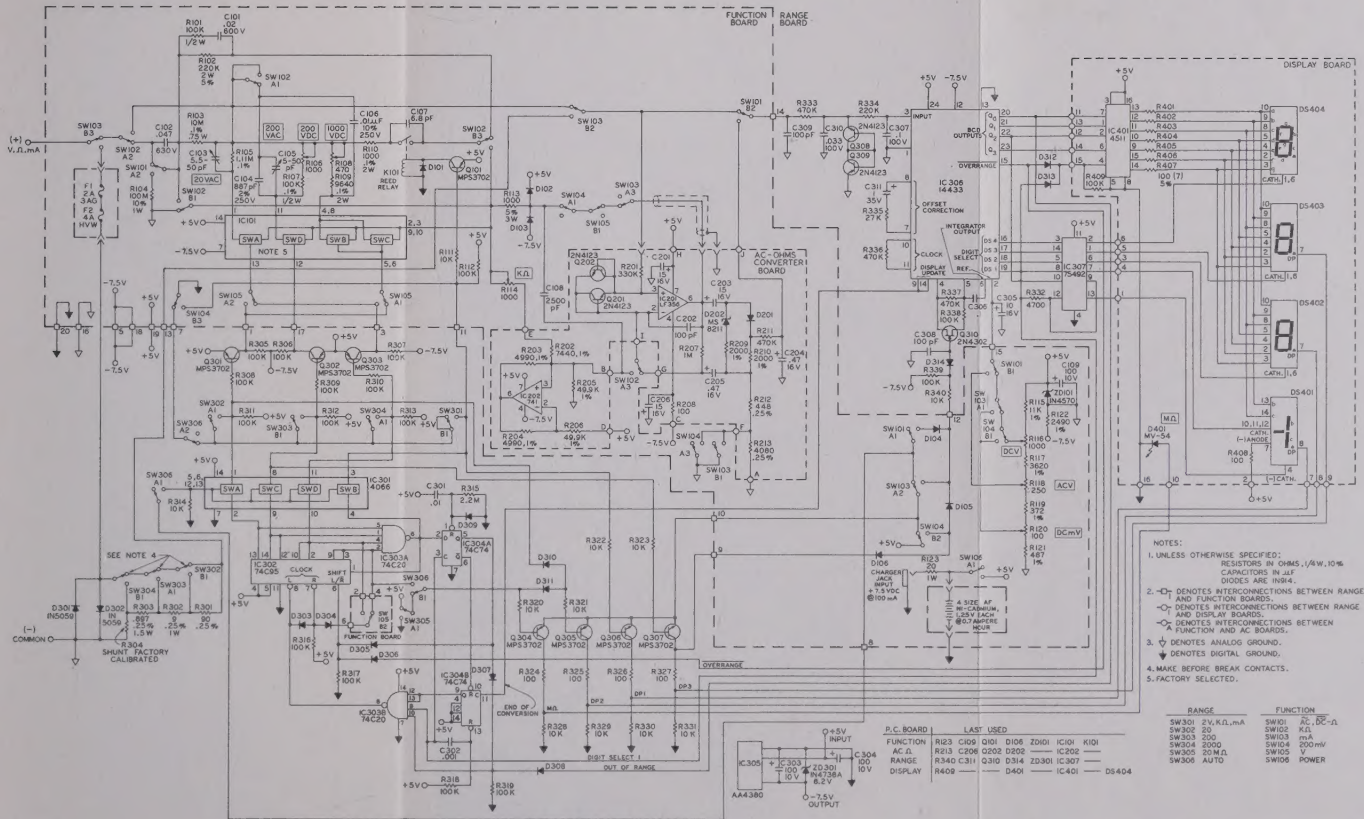
FUNCTION BOARD
RANGE BOARD
AC-OHMS CONVERTER BOARD
DISPLAY BOARD
NOTES:
1. UNLESS OTHERWISE SPECIFIED: RESISTORS IN OHMS, 1/4W, 10% CAPACITORS IN µF. DIODES ARE IN914.
2. DENOTES INTERCONNECTIONS BETWEEN RANGE AND FUNCTION BOARDS. DENOTES INTERCONNECTIONS BETWEEN RANGE AND DISPLAY BOARDS. DENOTES INTERCONNECTIONS BETWEEN FUNCTION AND AC BOARDS.
3. DENOTES ANALOG GROUND. DENOTES DIGITAL GROUND.
4. MAKE BEFORE BREAK CONTACTS.
5. FACTORY SELECTED.
RANGE
SW301 2V,KΩ,mA
SW302 20
SW303 200
SW304 200Ω
SW305 20MΩ
SW306 AUTO
FUNCTION
SW101 AC, DC-Ω
SW102 KΩ
SW103 mA
SW104 200mV
SW105 V
SW106 POWER
P.C. BOARD | LAST USED
FUNCTION | R123 C109 D101 D106 ZD101 IC101 K101
AC Δ | R213 C206 D202 D302 ——— IC202 ———
RANGE | R340 C311 Q310 D314 ZD301 IC307 ———
DISPLAY | R409 ——— D401 ——— IC401 ——— DS404
SEE NOTE 4
SHUNT FACTORY CALIBRATED
4 SIZE AF NI-CADMIUM 1.25V EACH @0.7 AMPERE HOUR
OVERRANGE
END OF CONVERSION
DIGIT SELECT 1
OUT OF RANGE
AA4380

Figure 6-2. 462 Schematic Diagram

Quality is the indispensable component of every Simpson instrument . . . . . .